REMARKS/ARGUMENTS

Reconsideration of this application is respectfully requested.

In response to the restriction requirement, the undersigned hereby does confirm the provisional election of Invention I, comprising claims 1-4 drawn to a process of making an electrical coil. However, this restriction requirement is respectfully traversed.

The sole basis relied upon in making this restriction requirement is the Examiner's allegation that the product of claim 5 can be made by a materially different method, "such as one that includes forming the final structure of a coil pattern by coating techniques, with no cutting or punching as required in Group I". However, that cannot possibly be the case because claim 5 is merely a product-by-process claim which covers only a product made by the method of claim 1. Furthermore, although the Examiner does not identify any particular "coating" technique that might be utilized to realize a similar coil structure, it is believed that any coil made by the building up of conductive coatings in a pattern on a substrate would be materially different in appearance, quality, performance and possibly other attributes from a product made in accordance with applicant's claimed method. For example, it is believed that it would be quite laborious and difficult and possibly impossible to achieve the same kind of repeatability and accuracy obtained by the applicant's claimed cutting methodology.

Accordingly, it is respectfully requested that the outstanding restriction requirement be withdrawn.

The rejection of claims 1-4 under 35 U.S.C. §102 as allegedly anticipated by Henke '214 is respectfully traversed.

The Examiner's refusal to give patentable weight to any of the limitations of claim 4 due to the alternative language "cutting or punching" found in claim 1 is not understood. Clearly the additional recitations of claim 4 (which require the pattern to be cut using a laser or water jet) do further limit the claimed process. Accordingly, it is believed that patentable weight must be given to the additional limitations of claim 4. The Examiner's assertion that somehow the applicant has "selected" the limitations of punching by using alternative language in claim 1 is not understood. As the Examiner has conceded, claim 1 covers methods using either cutting or punching. Although punching may be a species of cutting, no "selection" has been made by the alternate claim language. Claim 4 obviously is directed towards further limitation of the cutting alternative.

Henke stamps a single coil turn from sheet material. One of the legs is initially created at an outwardly projecting angle as shown by dotted lines at 5 in Fig. 3. After stamping, the outwardly projecting portion 5 is reformed back to the full line position shown in Figure 3 by mechanical deformation thus creating an overlapping unconnected corner 6. The main idea in Henke is to produce such open individual turns so that they can be individually placed around a continuous transformer core. The adjacent unconnected corners are then separated and electrically connected to similar adjacent turns at the overlapped corners (e.g., as shown in Figs. 1, 2 and 4).

The Henke teaching has been available since April 14, 1931. In spite of that, very sophisticated workers in the art of design and manufacture of magnetic resonance imaging/spectroscopy (MRIS) shim coils have not found the Henke teachings (or any similar such teachings) to be suited for the manufacture of MRIS shim coils.

The above-amended claims are now directed to a method of forming an MRIS shim coil. The applicants believe that the prior art does not disclose or suggest the formation of MRIS shim coils by the claimed techniques.

Shim coils have been known and used in MRIS for many years. Traditionally they have operated in a manner different from gradient coils and have been powered continuously to correct intrinsic errors in a magnet's main field. Typically they have carried 2-4 amps DC and have been wound out of rectangular section lacquered wire. The assertion has been made that as shims have different angular and/or mirror symmetry from gradient coils, low voltages are induced in the shims by the pulsing gradients and therefore shim coils were treated as low voltage components.

It was considered in the art that punching (or stamping) was an inefficient way of manufacturing shim coils of 1-2 square mm cross-section, particularly as the punching mark-space ratio would be about 1:1 in this case. Furthermore, punched coils need a substrate so the overall filing factor would be 25%. It was also considered that punching was an inefficient use of machinery, due to the long punching lengths required in thin material.

As MRIS has developed, the use and environment of shims has changed. Shim coils are now used dynamically to optimize field homogeneity for particular regions of a subject during an

imaging sequence ("in-vivo shimming"). Switching of such shims requires higher voltage amplifiers, especially if they have turns and high inductance. It has also been found that vibration-induced voltages in high field magnets need to be countered by higher voltage shim amplifiers.

As higher field magnets have been developed, the shim magnetic field strength required for in-vivo shimming has increased proportionately. Furthermore, higher field main magnets require more degrees of freedom in shimming. The extra, higher order, shims are relatively weak, so there is a demand for more and more stronger shims.

It has been realized by the present inventors that shims of many turns, operating at low current, create at least two problems:

1. they can become self-resonant, de-stabilizing the whole MRIS system, and

2. individual sub-modules may act as step-up transformers, generating large layer-to-layer voltages within a stack of shims, even though as a whole, shim coils may be decoupled from the gradient coils by symmetry.

It has now been recognized that these problems can be alleviated by adopting higher current shims with fewer turns. A typical shim can now carry up to 10 amps and the present inventors have appreciated that the previous prejudice against using punching is not now valid and that punching now is more appropriate for situations where currents are 10 amp rather than 2-4 amp.

Shims are no longer regarded as low voltage devices, due to dynamic shimming and to interlayer voltages as referred to above.

The present inventors believe it was not obvious to others in the art that, due to changed circumstances surrounding use of shims in MRIS systems, the previous prejudice against using punching for shim coils become no longer valid and that punching is now discovered as a suitable technique for the protection of efficient and effective shims.

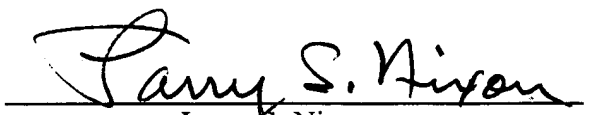
Attention is also drawn to the attached Form PTO-1449 and to the US patent therein referenced, namely, Droz USP 6,176,010. This is believed to be the US equivalent of a Chinese patent document previously cited against a Chinese counterpart of the present application. It will be noted that this reference describes the use of stamping processes for creating minute printed circuit coils on chip cards or the like without removing conducting material, etc. Once again, this prior art technique is not directed towards the creation of MRIS shim coils.

Attention is also drawn to new claims 6-10. New method claim 6 recites an embodiment of applicant's invention in more detail wherein an electrical MRIS shim coil is made by creating plural adjacently positioned MRIS shim coil windings by cutting and removing material from a continuous sheet of electrically conductive material along spaced apart paths. The windings are physically retained in adjacent as-cut positions by an insulating substrate adhered to the conductive material. The cutting step includes removal of conductive material along a cutting path by a process including at least one of: punching, stamping, laser beam and water jet cutting processes. Dependent method claims 7-9 add further patentably distinguishing detail. New product-by-process claim 10 also depends from new independent claim 6.

Accordingly, this entire application is now believed to be in allowable condition and a formal Notice to that effect is respectfully solicited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: 

Larry S. Nixon
Reg. No. 25,640

LSN:vc
901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100